RECENT WORK IN THE TELEGRAPHIC TRANSMISSION OF PICTURES.

COMMERCIAL photo-telegraphy may be said to have started in November, 1907, when Prof. Arthur Korn installed three of his selenium instruments at the offices of the *Lokal Anzeiger*, in Berlin, *L'Illustration*, in Paris, and the *Daily Mirror*, in London; towards the end of 1908 a further selenium apparatus was installed at Manchester. These early machines depend on the sensitiveness to light of one modification of the element selenium—selenium of the slate-grey form distributed over two platinum coils wound one between the other over a flat rectangular plate of steatite, being termed a selenium cell. Current was passed from a battery through the cell, on which was cast illumination from a Nernst lamp, the rays of which had first to pass through a revolving transparent photographic film, so that the intensity varied each instant according to the density of the photograph. A second cell was illuminated simultaneously by suitable means, the two being connected up on opposite sides of a Wheatstone bridge, so that the current sent to the receiving machine varied as the difference of the reciprocals of the resistance of the two cells. By combining suitable cells the inertia was largely overcome, and a photographic portrait could be transmitted in twelve minutes. The current at the receiving station passed into a string galvanometer, and laterally displaced a small shutter attached to the "strings," this movement cutting off more or less of the light projected from a second Nernst lamp on to a sensitive photographic film revolving synchronously with the transmitting cylinder, and one-quarter its size.

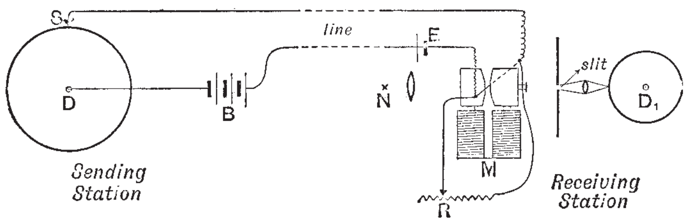

FIG. 1.

The disadvantage of this system is that the current transmitted is so small that when there is much leakage on the line it is difficult to get sufficient movement in the shutter of the galvanometer to give a useable result. The maximum current obtainable at the receiving station is about one milliampere. Prof. Korn's telautograph, which he completed in 1908, was therefore a great advance, as, the resistance of the line and the galvanometer being R and r respectively, the current C is proportional to $E/R+r$; hence by increasing the electromotive force, more current—up to 20 milliampères—can be obtained, and the induction effects from neighbouring lines are very much less pronounced.

The principle of the telautograph of Prof. Korn is seen in diagram form in Fig. 1. Here D is a cylindrical drum about 10 cm. diameter and 12·5 cm. in length, which is revolved at the rate of 30 r.p.m. by a high-speed motor suitably geared down; S is a steel stylus which is mechanically moved laterally at the rate of about 1 cm. in 40 seconds, and thus S traces a spiral path over the drum D. To D is attached a piece of copper foil, on which has been drawn a sketch or copy of a photograph in some insulating ink; more recently a single line half-tone reproduction of a photograph in fish-glue on metal foil has been transmitted with considerable success. B is a battery of thirty to sixty volts, and the telephone line is represented by dotted lines. A condenser is usually shunted across SD to prevent sparking, about one microfarad being necessary. At the receiving station we have a drum D, of ebonite, on which is wrapped a piece of sensitive photographic film or paper, this revolving in a light-tight box, and also moving laterally in corresponding manner to the transmitter. In the front of the box is a lens and small diaphragm, concentrating as a small spot on the film whatever light passes through a fine slit; this slit lies on the optic axis of a condensing lens fixed in front of the Nernst lamp N, the rays of which pass through a hole bored in the pole pieces of a strong electromagnet M, absorbing about 100 watts. A fine flat silver wire is stretched across the magnetic field, as shown in the figure, through which the current received passes; the shadow of this wire, when *no current passes, i.e.* when the stylus S is separated from the metal on D by an insulating line of the picture, just covers the slit, but when the stylus is in contact with the metal, and current flows through the circuit, the wire is displaced, and light therefore falls upon the sensitive film.

If the period of swing of the galvanometer wire nearly coincides with the period n/t of the currents sent from the transmitter—n being the number of lines per centimetre and t the time taken for a point on the circumference of the cylinder to travel 1 centimetre—there is a great tendency for the wire to vibrate intensely and so not respond exactly to the widths of the lines, which widths constitute in effect the tones in the photograph. Also in transmitting a half-tone photograph with n lines per centimetre, there is always a tendency for the wire to swing with a frequency n/t. A very dead-beat effect is, however, obtained by inserting a cell in the line circuit, and shunting a regulating resistance on the galvanometer, as indicated in Fig. 1, and by keeping the moment of inertia of the string to a minimum value.

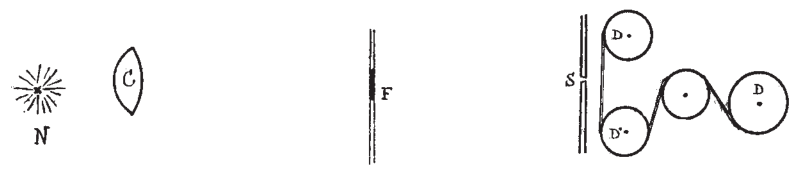

FIG. 2.

I have obtained useful photographic records of the movements of a string galvanometer of very small inertia, in the manner shown in Fig. 2. Here the light from a Nernst lamp N is projected through the hole in a string galvanometer, where it is intercepted by the magnesium shutter F attached to the strings; the shadow of the foil covers a slit S (perpendicular to the surface of the paper), and as F moves aside (when current passes through the wires), the effective width of the slit is increased; a revolving sensitive film is actuated by the drums DD, worked by clockwork. The result of transmitting a half-tone photograph, and receiving the same by optical

photographic means,' is seen in Figs. 3 and 4; an artificial line was used. By means of this apparatus much valuable information has been obtained relative

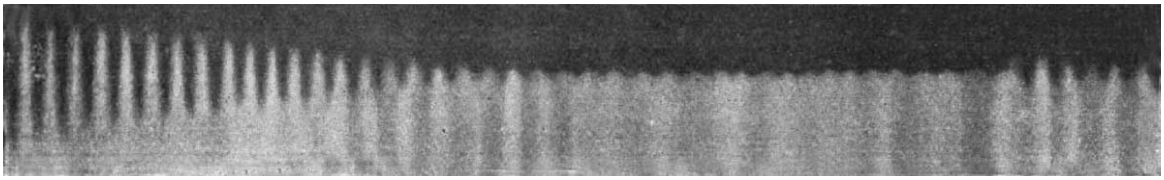

FIG. 3.—A graduating tint in a half-tone photograph represented as a series of waves of diminishing intensity.

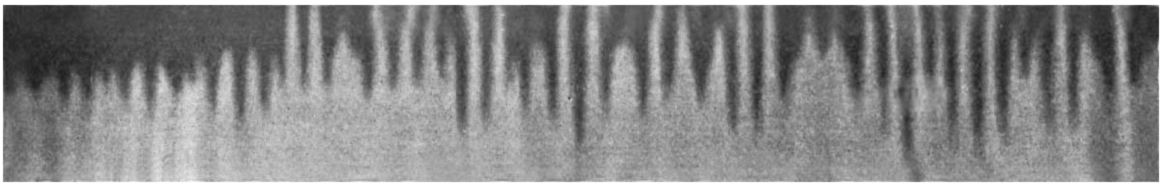

FIG. 4.—Dots of varying size in face oi a portrait epresented as waves with different maximum ordinates.

to the effects of capacity and inductance in long cables, some particulars of which I hope to publish

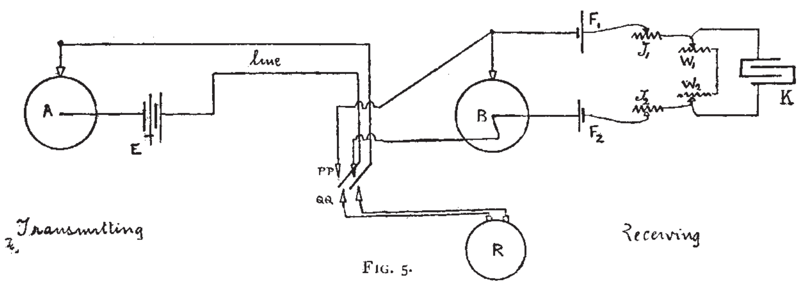

FIG. 5.

shortly; the effect of capacity is to widen the "teeth" and make one run into the next.

The telectrograph, which is at present being extensively used for transmitting news photographs from Manchester and Paris to London, is a modification of the Bakewell apparatus, and its essential feature is the balancer or compensator for overcoming the capacity and inductance effects of the line—distortion and "leads" of waves. The apparatus is seen in Fig. 5. Here A is a brass drum to which is attached the half-tone photograph—printed upon lead sheet, and pressed therein so that an even surface is offered to the stylus, which is provided with an iridium point E is the sending battery. The current received flows into two tongues, which are ordinarily in contact with the platinum pins PP, which lead the current to the drum and stylus of the receiver, on the former of which is placed moist absorbent paper containing the necessary chemical matter to give, by electrolysis, a coloured mark when current passes through it. At the end of the revolution, which is finished *before* that of the transmitting cylinder, a metal check arrests further movement, and the motor merely revolves a friction clutch. When the transmitting cylinder has now completed *its* revolution, the tongues being now in contact with the pins QQ, a contrary current is transmitted by means of a reverser, and this passes into the polarised relay R. The relay actuates, through a local battery, a magnetic release which draws away the check, so that the receiving drum starts off again. This means of synchronising is one in frequent commercial use, and was employed by Prof. Korn in his telautograph, and (with slight modification) in his selenium machines.

Now if a photograph transmitted as above be received direct on the chemically prepared paper, it would be blurred beyond recognition, owing to the distortion and the secondary discharges due to the line, A small dot would appear elongated as follows:—Where a succession of dots should be received, each one would run into the next, and if at a certain moment the action, after such a series of dots,

FIG. 6.—Telectrographed from Manchester to London.

FIG. 7. Telegraphed over artificial line of 2000 Ω by Thorne-Baker telectrograph.

should cease abruptly—corresponding to a "white" or "high-light" in the photograph—it would, on the

contrary, not cease for perhaps a quarter of a second, a tapering chemical line trailing after the last correct mark. The balance as shown in Fig. 5 effectually stops this; two secondary cells, F_1 and F_2, are shunted on to the line through variable inductances, J_1 and J_2, and send a reverse current into the line and variable resistances, W_1 and W_2, while from the sliding contacts of the latter a variable capacity K is fitted. By carefully observing the character of the image on B during the first two or three revolutions, one can at once counteract the line effects by regulation. In the Thorne-Baker telectrograph there are seventy-five turns of the cylinder per inch travel of the stylus, and the cylinder revolves once in two seconds. A result obtained with it over an artificial line (resistance of 2000 Ω) is shown alongside one transmitted from Manchester to London (Figs. 6 and 7). Fig. 8 shows a photograph transmitted by Korn's telautograph from Berlin to Paris, and Fig. 9 a line drawing transmitted by that system over an artificial line of resistance 1000 Ω.

Experiments are at present being made to transmit pictures and photographs by wireless telegraphy, but considerable modification of the ordinary arrangements is necessary, as the number of signals to be sent per second is very much greater than in the case of word telegraphy. The problem is, in fact, comparable with that of wireless telephony, whilst synchronisation has also to be arranged. The later results I have obtained with purely experimental apparatus are sufficiently good technically to show that the problem is one within the limits of commercial practicability.

T. THORNE-BAKER.

FIG. 8.—Telegraphed from Berlin to Paris by Korn telautograph.

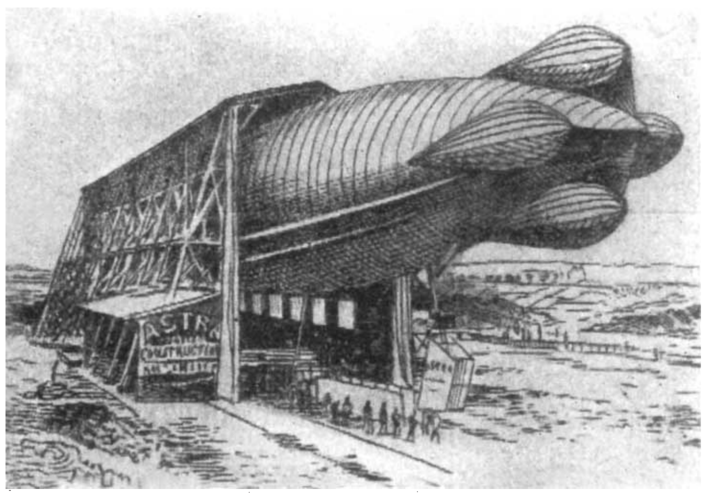

FIG. 9.—Telegraphed over an artificial line of 1000 Ω by Korn telautograph.

SIR CHARLES WILSON.[1]

THE life of Sir Charles Wilson, by his friend Colonel Sir Charles Watson, belongs emphatically to that class of biography which, as Carlyle held, ought to be written. Whether it is destined to be read by any large circle is another question. We might occupy much space in a discussion as to the exact degree of distinction in the subject that justifies a published biography were it not a question that settles itself automatically. We may, at any rate, congratulate the future historians of the Victorian and post-Victorian epochs in that they will have to look for their raw material, not among dusty and almost illegible manuscripts, but plainly set out in fair print and duly classified and catalogued by the librarians. Of such materials as this "Life" will future history be made.

Wilson's career was one of those which are still common in this country, but tend to get rarer and rarer with the advance of democratic ideals, a career devoted to the public service, and of the highest usefulness, unrecognised by, and almost unknown to, the ordinary world of newspaper readers. We might, if inclined to a satirical vein, say that its very obscurity is the best evidence of the value of such a career, seeing that it is often only on some shortcoming, either actual or supposed, that the outside world becomes conscious of the existence of the man in question. Thus in Wilson's case, were it not for the accusations, long since withdrawn as totally unfounded, of a failure on his part to do all that was humanly possibly to relieve Khartum before its capture by the Mahdi, his name would possibly be little known.

Passing over the period of childhood and adolescence and his entry into the Royal Engineers, the first important post that Wilson filled was that of secretary to the British Commission for delimiting the boundary between the United States and Canada from the Lake of the Woods to the Pacific along the 49th parallel of latitude. This line was marked out by astronomical methods, a procedure now known to be liable to the defect that the observations at each station are subject to an unknown error due to the force of local attraction or the deflection of the level. At the present day such a line would be delimited by means of a triangulation. In 1858, however, survey methods had not developed enough for this to be practicable, at all events within any reasonable limit of time, and the only possible course was taken. That the line as then marked out, and as it remains to this day, was not a true parallel of latitude, but a wavy line departing from the truth to distances of some hundreds of feet on either side, was of secondary importance. The urgent point was to get some acceptable boundary laid out upon the ground, and so marked that nobody could have any doubt as to which side of the line they were on at any given moment.

With the technical work of the Commission in the field, Wilson had, however, little to do; his duties were of a more arduous character. The

[1] "The Life of Major-General Sir Charles William Wilson, Royal Engineers, K.C.B., K.C.M.G., F.R.S." By Colonel Sir Charles M. Watson, K.C.M.G. Pp. xv+419. (London: John Murray, 1909.) Price 15s. net.